Great Reed Warbler

Acrocephalus arundinaceus

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Range

This species' huge breeding range extends from SW Europe eastwards to the Pacific coast of Asia. The nominate race breeds patchily in NW Africa, but widely in Europe, from the Iberian Peninsula and France east to the Caspian Sea, and north to southern Scandinavia (Cramp, 1992). The nominate race winters south of Sahara, from Sierra Leone to southern Ethiopia and South Africa (Del Hoyo et al., 2006) and exhibits strong natal and breeding philopatry (Hansson et al., 2002). Regarding the study sites, it breeds in all Catalan and Balearic wetlands and at Larache (N Morocco), but even there the vast majority of captures are of non-local migrants.

Migratory route

Few recoveries of the species are direct, although most show a clear SW-NE orientation, connecting the study area with its C and NE European breeding areas (fig. 1). Flight directions of birds from Els Columbrets/Balearic Islands and continental Spain are similar, although those from the islands tend to originate from a narrower southern range of latitudes (mostly northern Italy and Czech Republic), while those from the Iberian Peninsula come from further north (northern Germany to southern Sweden). This suggests some differentiation in the origins of individuals migrating through the study area, although the sample size is too small to be conclusive.

Connectivity areas in Central and NE Europe are similar to those reported in birds trapped in spring in Italy, mostly on the Tyrrhenian coast (Spina & Volponi, 2009). Therefore, these populations may return to breeding grounds either using a more continental and lengthy route through Morocco and Spain, or a more direct one crossing the Mediterranean and continuing up the Italian peninsula. Interestingly, birds crossing the Tyrrhenian islands are larger (mean 74.5, n = 61; Spina et al., 1993) than in Catalonia and the dry Balearics, but their body mass and physical condition are 9% and 14% lower than in Catalonia and 4% and 12% lower than in dry Balearics.

The scarcity of captures in the dry Balearics and Els Columbrets is notable (fig. 2), although the fact that this species is nearly always captured in wetlands indicates a strong selection of reed beds or similar vegetation types on stopovers during migration.

Phenology

The first birds are captured at the end of March and then the frequency increases steadily from mid-April to a peak in the first half of May (fig. 3). Numbers remain high until the end of May. The low proportion of breeding birds in the dataset implies that passage continues well into early June. Birds captured during the first half of May are ringed/recovered distinctly further north than birds trapped earlier, suggesting that later birds could belong to more northerly populations. The main passage is similar in Catalonia and the Balearic Islands/Els Columbrets, but *c.* 1-2 weeks earlier in N Morocco and, apparently, somewhat earlier also in Malta (mostly mid-April to mid-May; Sultana & Gauci, 1982). In accordance with findings presented here, published data from Morocco show that birds usually arrive there from early March onwards, but that the main passage period peaks in mid-April to mid-May (Thévenot et al., 2003; Gargallo et al., unpubl.).

Biometry and physical condition

Mean third primary length ranges from 72.4 in dry Balearics to 74.1 in wet Balearics (table 1), slightly shorter than measurements reported in the C Mediterranean (mean 74.5, n = 61; Spina et al., 1993). Mean values of wing length vary between 93.8 in N Morocco and 97.4 in Columbrets, and are within the range reported elsewhere in W Europe (Cramp, 1992). Mean body mass varies from 25.5 in Els Columbrets to 31.6 in wet Balearics, while mean fat score is most often between 2 and 3. Birds trapped in wet Balearics have the highest average body mass, while those from N Morocco and Catalonia are significantly heavier than in the dry Balearics and, noticeably, Els Columbrets (fig. 8, table 1). Identical results are found for physical condition (fig. 7). Mean fat does not differ statistically between Catalonia, Els Columbrets and the dry Balearics, where birds have significantly less fat than in the wet Balearics; in N Morocco birds attain the maximum average (fig. 9).

Third primary length decreases with a similar gradient in all localities, reflecting the earlier passage of males (of larger size; Cramp, 1992), and has a significantly lower average in N Morocco (fig. 6, table 1). There is no clear temporal trend in fat score and physical condition, but body mass tends to decrease slightly (figs. 7-9). Average body mass of birds captured in N Morocco is *c.* 9% above that reported for SE Morocco (27.1, n = 24; Ash, 1969; Gargallo et al., unpubl.) and mean fat is also higher (mean in SE Morocco 2.9, n = 12; Gargallo et al., unpubl.), suggesting birds use the former area to regain energetic reserves after crossing the Sahara and in preparation for reaching Europe. This view is further supported by stopover data (see below) and the fact that while the species largely overflies NW Africa in autumn, it is much more common or at least regular there in spring (Cramp, 1992; Isenmann & Moali, 2000; Thévenot et al., 2003; Isenmann et al., 2005). Once in Europe, birds seem to be able to regain some mass along the route. Body mass in Catalonia is very similar to N Morocco (although fat and physical condition are lightly lower) and further north in S France and Fair Isle (Scotland) reported averages are even slightly higher than in Catalonia (means 30.9 [n = 6] and 31.6 [n = 4], respectively; Cramp, 1992).

On the other hand, in the dry Balearics and on Els Columbrets body condition is distinctly lower than in continental NE Spain and N Morocco and even lower than in birds trapped in W Europe during the breeding season (means *c.* 28.1-30.1; Cramp 1992; ICO, 2010), indicating that the sea-crossing is very demanding. A markedly different situation is encountered in the wet Balearics, where birds are in distinctly better condition, even in comparison to Catalonia. These vital wetlands are the only suitable habitat for the species in these islands and may therefore allow higher mass gains than the other areas. Moreover, being located on larger islands can involve a smaller proportion of recently landed birds and of birds in poor condition needing to stop at the first available site, all these factors positively influence body condition. The higher body mass in comparison to Catalonia may reflect the fact that birds trapped in these insular wetlands hurry to gain weight so as to be able to finish their sea-crossing.

Stopover

Data on stopovers are very scarce except in mainland Catalonia (fig. 5, table 2). The proportion of retrapped birds is highest in Catalonia and N Morocco, the only sites where fuel deposition rates are significantly positive (moreover in Catalonia retrapped birds have significantly higher masses when last captured). The minimum stopover duration is also higher in these areas, but differences only significant between Catalonia and the wet Balearics. In the dry Balearics retrapped birds tend to be lighter than birds that are not retrapped (contrary to the situation observed in the wet Balearics), suggesting that in general individuals in worse condition stay for several days in these areas; the sample size, however, is very small and differences are not significant. Data from Catalonia and N Morocco may include a few breeding birds; however, the fact that retraps show positive fuel deposition rates and that nesting birds are a minority suggest that these results are representative of migrants.

Overall, data support the role of N Morocco as a relevant stopover site and indicate that birds migrate through continental Spain maintaining their energetic balances and even increasing somewhat in mass. Retraps are strikingly low in the wet Balearics. This may indicate that the higher body mass in this area are more a reflection of the scarcity of birds forced to land due to poorer condition than to extended stays (in fact only 3% of birds in the wet Balearics have body masses below 25 g, but as many as 30% in the dry Balearics). However, a lack of retraps does not rule out the possibility that a certain number of birds trapped in these wetlands had already been on these bigger islands for a few days, but not necessarily at the ringing site.

Table 1. Mean (± SD), range and sample size of main biometric parameters according to area.

	n	Wing	Third primary	Body mass	Fat score
Catalonia	1,062	95.1 ± 3.1 (86.0-103.3)	73.1 ± 2.7 (65.5-80.0)	29.4 ± 2.8 (17.6-39.8)	2.3 ± 1.3 (0-8)
Columbrets	5	97.4 ± 4.9 (90.5-102.0)	73.9 ± 2.9 (72.0-79.0)	25.5 ± 3.5 (21.2-32.2)	1.1 ± 1.7 (0-4)
Balearics (dry)	59	93.9 ± 3.1 (88.0-100.5)	72.4 ± 2.8 (66.0-77.5)	27.8 ± 4.3 (19.3-39.2)	2.2 ± 1.6 (0-6)
Balearics (wet)	60	96.3 ± 3.0 (87.5-101.5)	74.1 ± 2.3 (69.0-78.0)	31.6 ± 4.0 (22.5-40.1)	3.3 ± 1.6 (0-6)
Chafarinas	0				
N Morocco	82	93.8 ± 3.6 (83.0-104.0)	72.5 ± 2.7 (66.5-79.5)	29.8 ± 4.3 (22.3-45.7)	3.6 ± 1.4 (0-7)
S Morocco	0				

Table 2. Variation in fuel deposition rate (g/day) according to area and type of retraps involved (mean ± 95% CI and sample size are given).

	Catalonia	Columbrets	Balearics (dry)	Balearics (wet)	Chafarinas	N Morocco
All retraps	0.30 ± 0.13 (169)		0.43 ± 0.83 (2)	0.90 ± 1.47 (2)		0.73 ± 0.46 (7)
Retraps >1 day	0.36 ± 0.11 (134)		0.43 ± 0.83 (2)	0.90 ± 1.47 (2)		0.70 ± 0.54 (6)

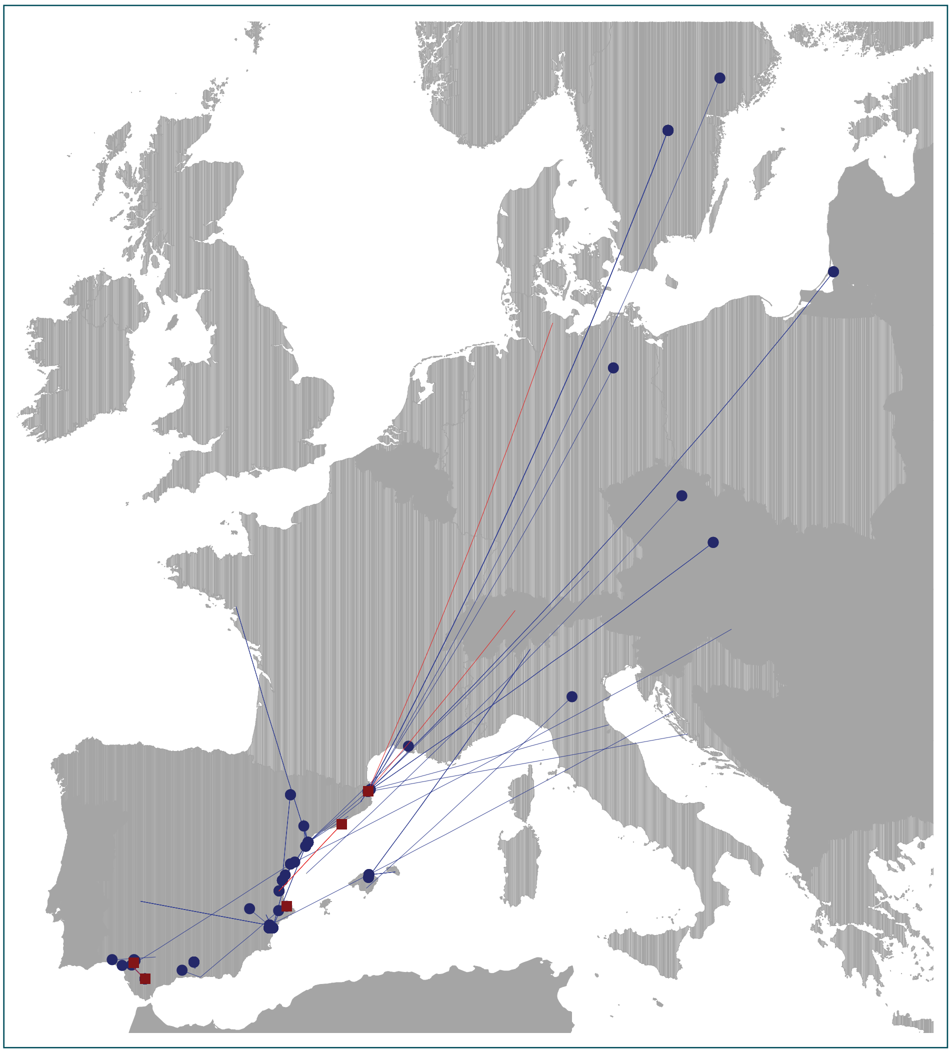


Figure 1. Map of recoveries of birds captured in the study area during the study period (March to May).

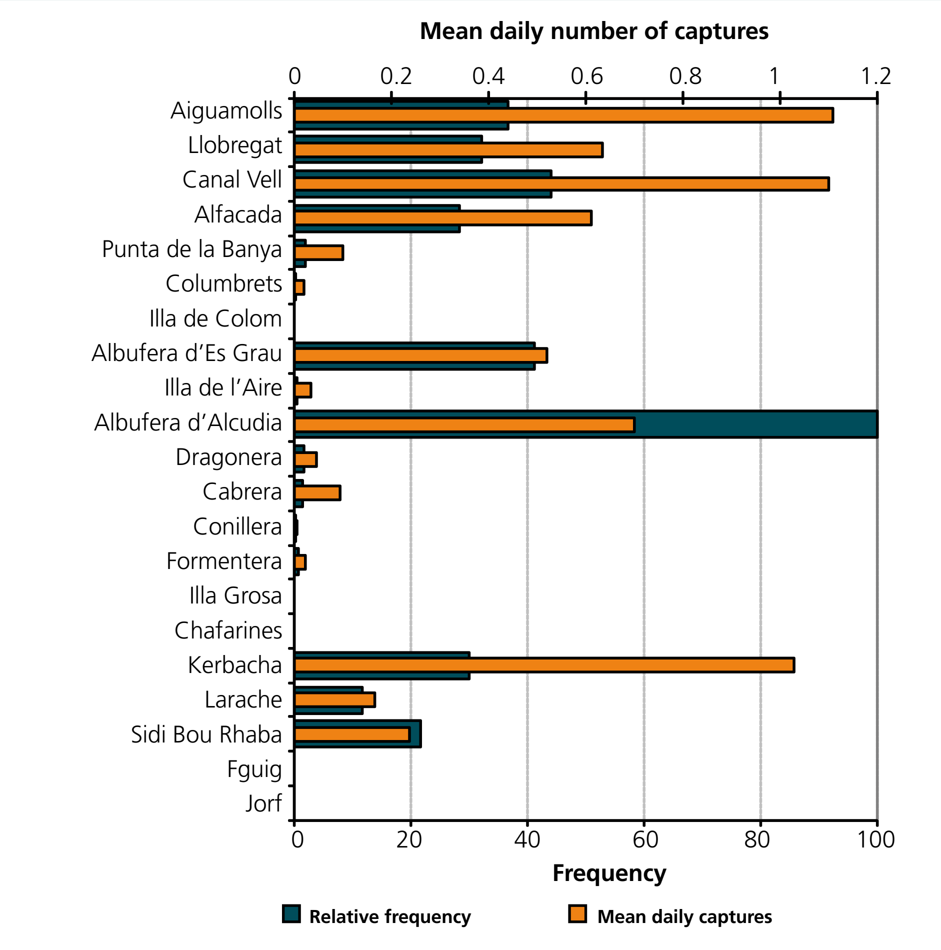


Figure 2. Relative frequency of captures and mean daily numbers according to site during the standard period (16 April to 15 May).

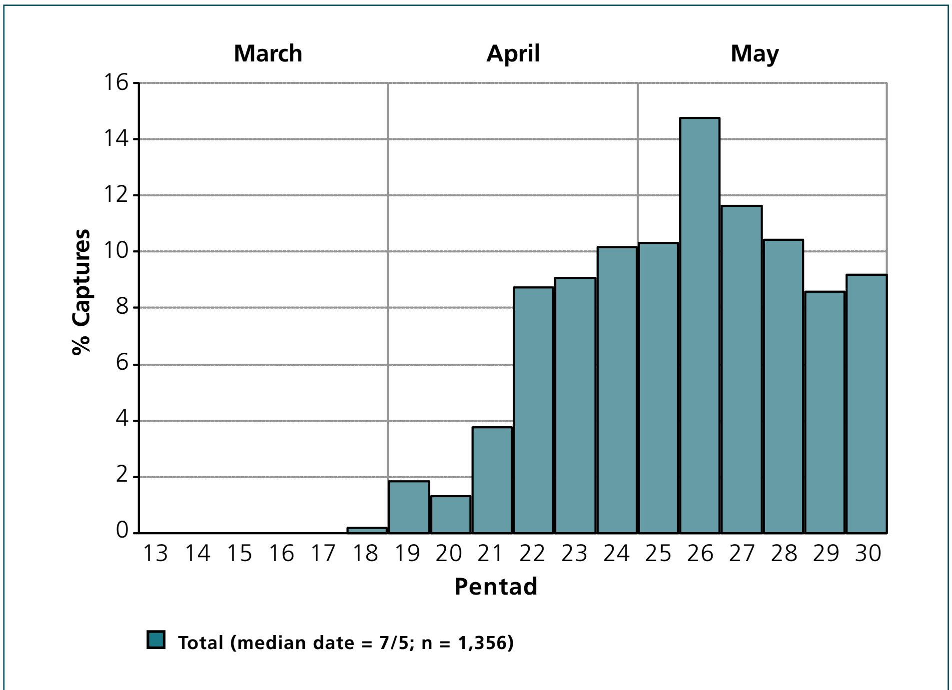


Figure 3. Frequency of captures during the study period.

Figure 4. Variation in body mass and fat score according to site during the standard period (16 April to 15 May).

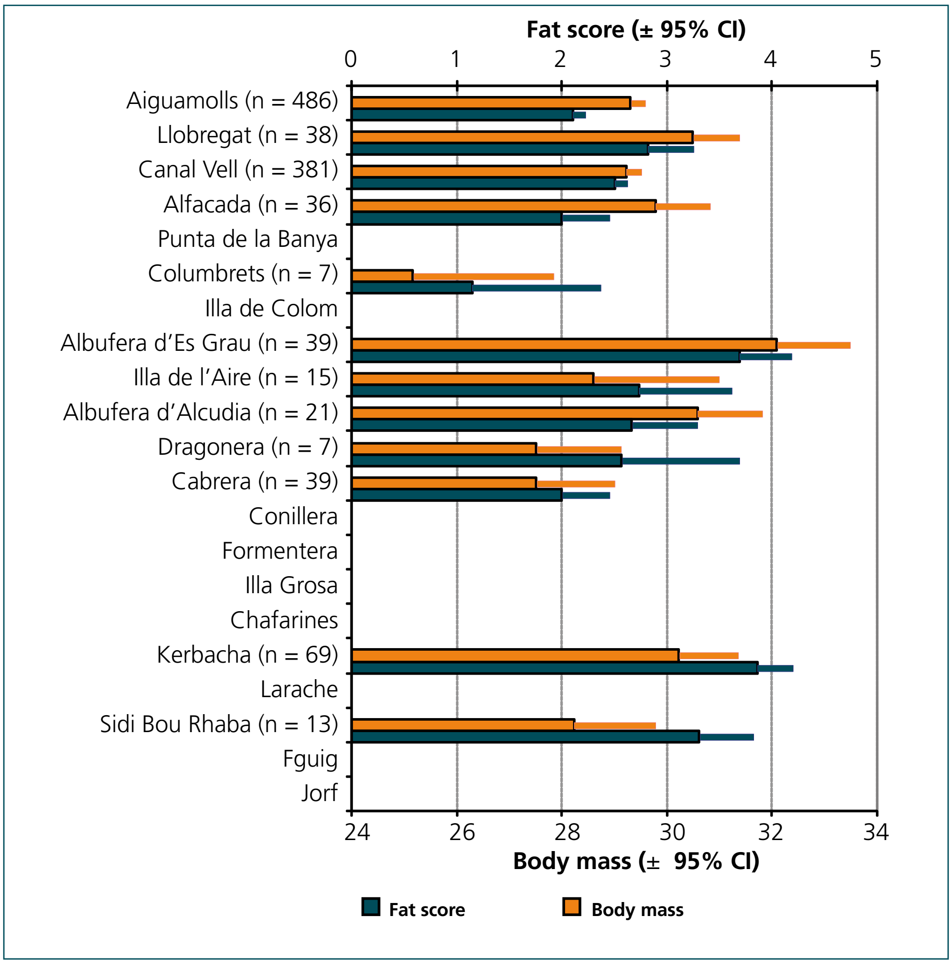
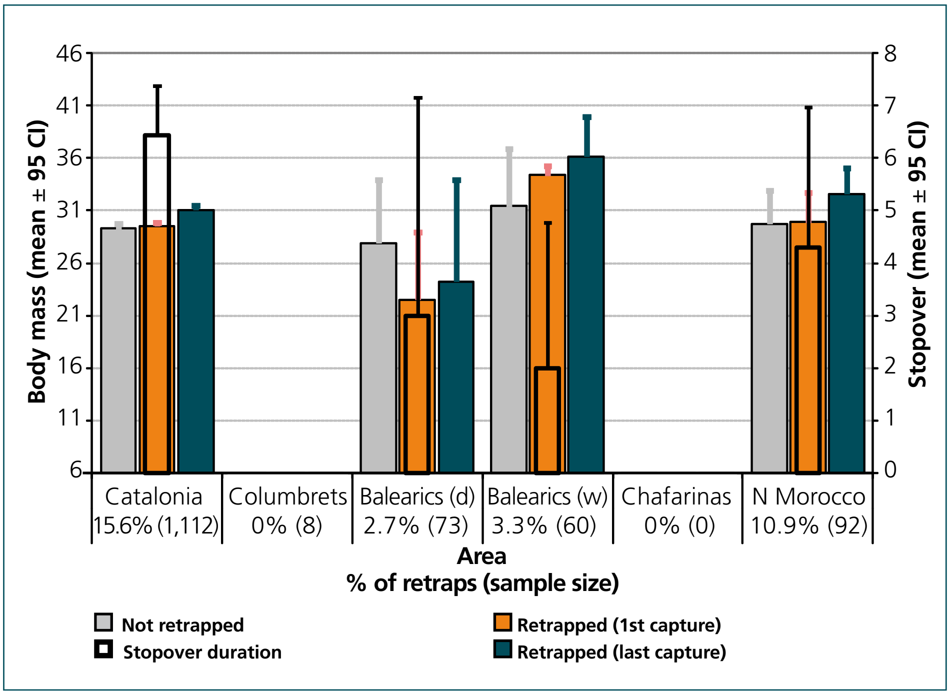


Figure 5. Variation in body mass by trapping status, minimum stopover length and frequency of retraps according to area.



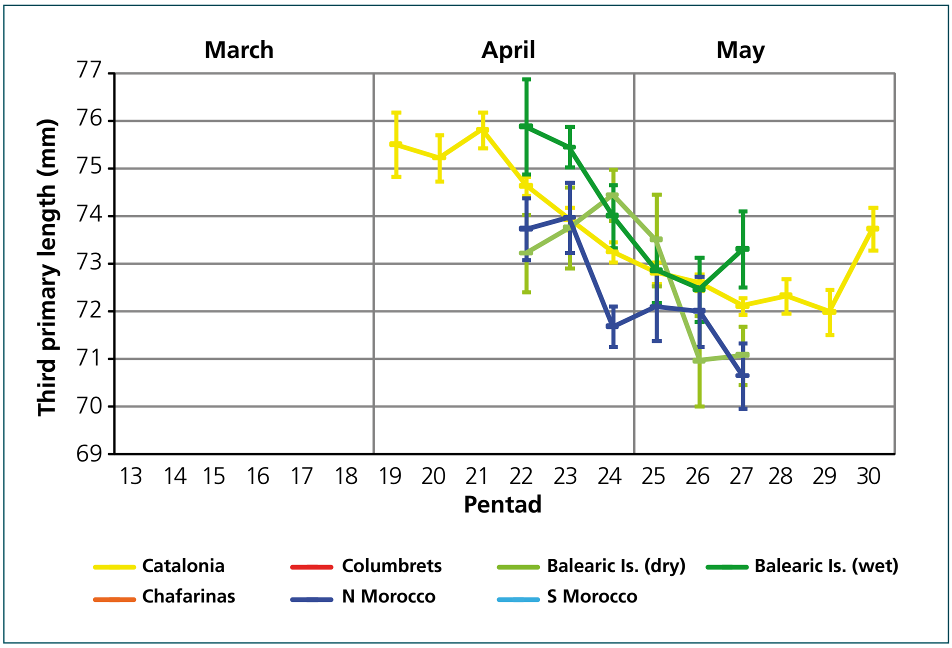


Figure 6. Temporal variation of third primary length according to area.

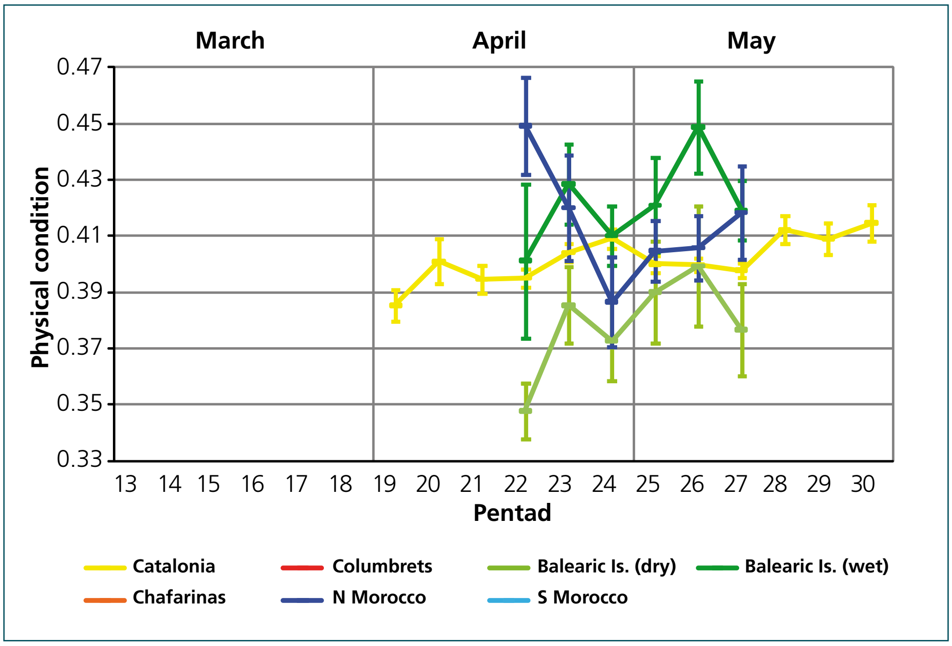


Figure 7. Temporal variation of physical condition according to area.

Figure 8. Temporal variation in body mass according to area.

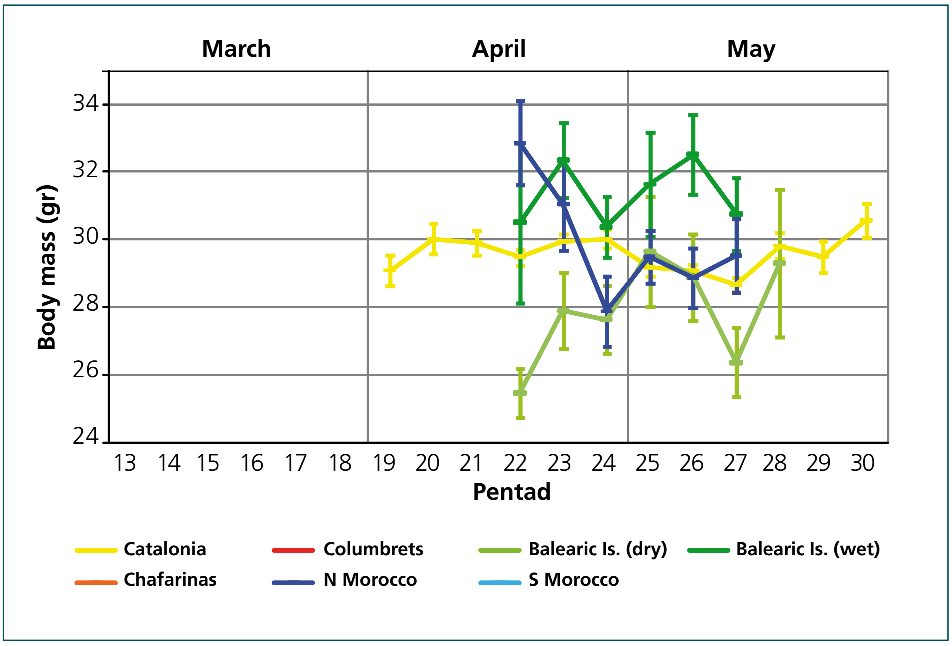


Figure 9. Temporal variation in fat score according to area.